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Contents: Static Magnetic Fields

Effective Date: **July 2004**

Point of Contact: [Static Magnetic Fields Subject Matter Expert](#)

Section	Overview of Content (see section for full process)
Introduction	
1. Static Magnetic Fields Hazard Assessment	<ul style="list-style-type: none">• Identify device and map magnetic field strength.• Compare results to BNL exposure limits.• Document the assessment.• Review hazard evaluations; reassess, if needed.
2. Static Magnetic Fields Exposure Controls	<ul style="list-style-type: none">• Implement administrative and work control measures.• Document control measures and review annually.

[Definitions](#)

Exhibits

[BNL Static Magnetic Fields Exposure Limits](#)
[Control Requirements for Static Magnetic Fields](#)
[Magnetic Forces on Ferromagnetic Objects](#)
[Safety Signs for Static Magnetic Fields](#)

Forms

[Static Magnetic Fields Exposure Form](#)

Training Requirements and Reporting Obligations

This subject area contains training requirements. See the [Training and Qualifications](#) Web Site.

This subject area does not contain reporting obligations.

References

American Conference of Governmental Industrial Hygienists (ACGIH)

BNL [Training and Qualifications](#) Web Site

DOE Order 440.1A, Worker Protection Management for DOE Federal and Contractor Employees

[Facility Use Agreements](#) home page (*Limited Access)

[Work Planning and Control for Experiments and Operations](#) Subject Area

*Access limited to BNL staff and authorized non-BNL staff.

Standards of Performance

All staff and guests shall comply with applicable Laboratory policies, standards, and procedures, unless a formal variance is obtained.

Managers shall analyze work for hazards, authorize work to proceed, and ensure that work is performed within established controls.

All staff and users shall identify, evaluate, and control hazards in order to ensure that work is conducted safely and in a manner that protects the environment and the public.

All staff and users shall ensure that they are trained and qualified to carry out their assigned responsibilities, and shall inform their supervisor if they are assigned to perform work for which they are not properly trained or qualified.

Management System


This subject area belongs to the **Worker Safety and Health** management system.

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Introduction: Static Magnetic Fields

Effective Date: **July 2004**

Point of Contact: [Static Magnetic Fields Subject Matter Expert](#)

This subject area describes procedures for the assessment and control of potential hazards associated with exposure to static magnetic fields. Potential hazards include forces on ferromagnetic objects and interference with various medical devices. In low magnetic fields, the functioning of cardiac pacemakers and similar devices are the only concerns. In high magnetic fields, forces on ferromagnetic objects and interference with various other medical devices (e.g., ferromagnetic implants and prostheses) become important. Other effects have not been shown to be harmful.*

Examples of devices that produce static magnetic fields at Brookhaven National Laboratory (BNL) are permanent magnets, Magnetic Resonance Imaging (MRI) equipment, Nuclear Magnetic Resonance (NMR) equipment, superconducting coils, accelerator magnets, detector magnets, dc magnets in radio frequency and microwave tubes, ion pumps, electron microscopes, beam transport magnets, and electromagnetic lifting devices.

This subject area applies to occupational exposures only. Research subject exposures have specific screening protocols under Food and Drug Administration (FDA) regulations and are administered by the BNL Institutional Review Board (IRB).

This subject area does not apply to unmodified consumer products (phones, computer terminals, magnetic stirring devices, refrigerator magnets, etc.) that are used as intended.

*While not a safety hazard, low magnetic fields have been reported to cause deletion of information on magnetic memory materials, such as those found on credit cards, identification badges, computer disks, and videotapes. The exhibit [Safety Signs for Static Magnetic Fields](#) provides an appropriate sign for posting.


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1. Static Magnetic Fields Hazard Assessment

Effective Date: **July 2004**

Point of Contact: [Static Magnetic Fields Subject Matter Expert](#)

Applicability

This information applies to Line Managers, Principal Investigators, and ESH Coordinators who are responsible for operations using devices that produce static magnetic fields.

Required Procedure

Line Managers or Principal Investigators (the Process Owners) conduct an initial hazard assessment on each device or system that produces static magnetic fields. The assessment consists of identifying the source, surveying the magnetic field strength and exposure potential, and evaluating the results based on the BNL exposure limits. ESH Coordinators assist in implementing appropriate administrative and work control measures. The assessment is reviewed and validated during reviews done in accordance with the [Work Planning and Control for Experiments and Operations](#) Subject Area, and the device is reassessed if modifications were made to it that may result in increased exposures or magnetic strength.

Use the [Static Magnetic Fields Exposure Form](#), or equivalent, to document the assessment.

Step 1	<p>Identify the devices within the work area that produce static magnetic fields. Unmodified consumer products such as phones, computer terminals, magnetic stirring devices, and refrigerator magnets do not need to be evaluated.</p> <p>Note: Use the building's Facility Use Agreement or an existing safety review document (e.g., Work Planning and Control for Experiments and Operations Subject Area) as a resource. If previously undocumented devices are found, previously documented devices have been significantly modified, or new devices were introduced into the building, the Process Owner ensures that the Facility Use Agreement is updated and the safety review documents are updated or initiated, as appropriate.</p>
Step 2	<p>Survey (map) the magnetic field strength (calculation or infield measurement) to</p>

	<p>determine the exposure potential of the devices. Use Part B: Field Strength Measurement Record of the Static Magnetic Fields Exposure Form, or equivalent, to document the survey.</p> <p>Conduct a personnel exposure assessment to determine if there is a potential for employees to be exposed above any of the BNL exposure limits. The Static Magnetic Fields Exposure Form, or equivalent, may be used. Submit a copy to the Static Magnetic Fields Subject Matter Expert, ESH Coordinator, and FS Representative.</p> <p>Note: Contact the Static Magnetic Fields Subject Matter Expert or your Facility Support (FS) Representative to arrange for assistance in performing in-field mapping, as needed.</p> <p>Note: Dosimetry is the preferred method to evaluate individual exposure. If dosimetry is not used, estimate exposure dose based on the worst-case exposure from area measurements.</p> <p>Note: Address personnel exposure during maintenance operations by organizations such as Plant Engineering in the work planning and control documentation.</p>
Step 3	<p>The Process Owner and the ESH Coordinator compare the results of the survey to the exposure limits in the exhibit BNL Static Magnetic Fields Exposure Limits and implement the appropriate administrative and work control measures. (See the section Static Magnetic Fields Exposure Controls.)</p>
Step 4	<p>Validate hazard evaluations during reviews done in accordance with Work Planning and Control for Experiments and Operations Subject Area. Reassess the hazard evaluation if new applications or modifications, or equipment upgrades and modifications result in increased or decreased exposures or magnetic strength.</p>

References

[Facility Use Agreements](#) home page (*Limited Access)

[Work Planning and Control for Experiments and Operations](#) Subject Area

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Subject Area: **Static Magnetic Fields**

BNL Static Magnetic Fields Exposure Limits

Effective Date: **July 2004**

Point of Contact: [Static Magnetic Fields Subject Matter Expert](#)

The following exposure limits were developed by BNL to ensure that personnel can safely perform work around static magnetic fields.

BNL Exposure Limits for Static Magnetic Fields		
<i>Areas of Concern</i>	<i>8-hour Time-Weighted Average (TWA)</i>	<i>Ceiling</i>
Medical Electronic Devices Wearers (e.g., cardiac pacemakers, electronic inner ear prostheses, insulin pumps)	--	0.5 mT (5 G)
Ferromagnetic Objects (includes tools and medical implants/prostheses)	--	60 mT (600 G)*
Whole Body	60 mT (600 G)	2 T (20,000 G)
Limbs	600 mT (6,000 G)	5 T (50,000 G)

*DOE Order 440.1A cites the American Conference of Governmental Industrial Hygienists (ACGIH) exposure limits as the Occupational Exposure Limits.


**The ferromagnetic magnetic objects ceiling limit is based on Fermi Laboratory guidance. See the exhibit [Magnetic Forces on Ferromagnetic Objects](#) for more information.

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Control Requirements for Static Magnetic Fields

Effective Date: **July 2004**

Point of Contact: [Static Magnetic Fields Subject Matter Expert](#)

The following tables provide control requirements for static magnetic fields.

Table A: Protection from Physical Hazards

Exposure Potential	Safety Signs*	Training	Hazard Potential
≥ 1 mT (10 G) Instantaneous	Yes (Sign #2)	No	Loss of data from magnetic storage media
≥ 60 mT (600 G) Instantaneous	Yes (Sign #3)	Yes	Attraction of ferromagnetic objects to magnet source

Table B: Protection for Individuals with Medical Electronic Devices and Ferromagnetic Prostheses

Exposure Potential	Safety Signs*	Training	Medical Evaluation	Entry into the Area
≥ 0.5 mT (5 G) Instantaneous (Ceiling)	Yes (Sign #1)	For people with medical electronic devices, supervisors, ESH Coordinators, Facility Support (FS) Representatives, Process Owners**	Initial evaluation required for those with medical electronic devices	No for individuals with medical electronic devices, unless permitted by medical evaluation
≥ 60 mT (600 G) Instantaneous (Ceiling)	Yes (Sign #3)	Required for ferromagnetic prostheses user (including aneurysm clips and medical electronic devices); their supervisors,	Required for ferromagnetic prostheses users (including aneurysm clips and medical electronic devices)	No for individuals with implants, unless permitted by medical evaluation

		ESH Coordinators, FS Representatives, Process Owners**		
--	--	--	--	--

Table C: Protection of Occupationally Exposed Workers

Exposure Level	Safety Signs*	Training	Medical Evaluation	Hazard Assessment
> 60 mT (600 G) Routinely	Yes (Sign #3)	Yes	No	<ul style="list-style-type: none"> Documented Hazard Assessment. Personnel Exposure Monitoring when there is a potential for exposure above the 8-hr. TWA or Ceiling.
> 60 mT (600 G) TWA - 8 hours to Whole Body	Yes (Sign #3)	Not to be exceeded. If exceeded: <ul style="list-style-type: none"> Medical Evaluation required. Corrective Action Plan required. Contact an ORPS Categorizer. 		
> 600 mT (6,000 G) TWA - 8 hours to Limbs	Yes (Sign #3)			
> 2 T (20,000 G) Instantaneous (Ceiling) to Whole Body	Yes (Sign #3)			
> 5 T (50,000 G) Instantaneous (Ceiling) to Limbs	Yes (Sign #3)			

*See the exhibit [Safety Signs for Static Magnetic Fields](#).

** Supervisors, ESH Coordinators, Facility Support (FS) Representatives, and Process Owners must receive training so that they are knowledgeable of the hazards and control requirements.

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Subject Area: **Static Magnetic Fields**

Magnetic Forces on Ferromagnetic Objects

Effective Date: **July 2004**

Point of Contact: [Static Magnetic Fields Subject Matter Expert](#)

The exhibit Magnetic Forces on Ferromagnetic Objects is provided as a [PDF](#) file.

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Magnetic Forces on Ferromagnetic Objects

Ferromagnetic objects can experience rotational and translational forces when immersed in a magnetic field. These forces can increase the risk of accidents associated with the use of common work materials (such as tools, carts, gas cylinders, and safety shoes) as well as medical complications (such as the dislodging of aneurysm clips). Following are mathematical descriptions of the forces. The model is complicated and is provided for reference purposes only. It should be noted that the model assumes that the ferromagnetic object is a sphere. It should be noted that assumptions for the shape and size of the object could cause a large underestimation of results (the difference between the forces on a sphere and a long cylindrical soft iron rod is on the order of 1,000). It is recommended that experimenters use one of the following methods to estimate forces on ferromagnetic objects.

- Use a physical device (e.g. a small-scale model) of a typical object to actually determine the effects on the object. Select an object which takes into account the size and type of material to be used in the field.
- Use a model simulation program such as
 - (a) Poisson for 2-dimensional models, or
 - (b) TOSCA for 3-dimensional models.

These programs take into account force variations due to size and type of material.

Small ferromagnetic objects, such as paper clips or washers hung from a string, can be used to indicate the presence of a field, but it must be determined separately if any hazards to personnel or equipment can result. Care should be taken in choosing the shape and size of the object (higher length-to-diameter ratio and/or the higher ferromagnetic property of the material will result in a stronger magnetic force). Any test procedures should be reviewed for safety prior to being performed.

Fermi Laboratory Background Information

Rotational Force

The torque experienced by a ferromagnetic object depends on the magnetic field strength:

$$L_{mag} = -mH \sin \phi$$

Where L_{mag} = torque experienced by the ferromagnetic object (N-m)
 m = magnetic moment of the ferromagnetic object (Wb-m)
 H = magnetic field density (A/m)
 ϕ = angle between the magnet moment and the field (°).

In 1987 at FERMI Lab's Fifteen-Foot Bubble Chamber, tests were performed on a wrench, nail, pen, clipboard, and safety shoes. The tests showed some interference at 30 mT (300 G), with significant interference at 60 mT (600 G) (these levels are compatible to the whole body 8-hour time-weighted average limit from the ACGIH). Rotational forces make normal handling of ferromagnetic objects almost impossible at 200 mT (2,000 G) field levels.

Translational Force

The translational magnetic force can be calculated from the gradient of the change in the magnetic field energy density resulting from the presence of the ferromagnetic object in the magnetic field.

$$F_{mag} = \nabla[(U - U_o)V]$$

Where F_{mag} = magnetic force on the ferromagnetic object (N)

∇ = gradient operator

U = energy density with ferromagnetic object (J/m³)

U_o = energy density without ferromagnetic object (J/m³)

V = volume of ferromagnetic object (m³).

The magnetic field energy density is given by:

$$U = \frac{1}{2} \vec{B} \cdot \vec{H}$$

Where B = magnetic flux density (T)

H = magnetic field density (A/m).

The magnetic flux density in the absence of the ferromagnetic object is:

$$\vec{B}_o = \mu_o \vec{H}$$

Where μ_o = permeability of free space = $4\pi \times 10^{-7}$ H/m.

The internal flux density of a ferromagnetic object is:

$$\vec{B}_o = \mu_{eff} \mu_o \vec{H}$$

Where μ_{eff} = effective permeability of the ferromagnetic material after correction for demagnetization.

The value of μ_{eff} is dependent on the material and shape and can vary greatly (i.e., a long thin soft iron rod can have an μ_{eff} 1,000 times greater than that of a sphere of the same material). If it is assumed that the ferromagnetic object is spherical (since other geometries are incredibly complicated), the internal magnetic flux density is:

$$\vec{B}_o = 3\mu_o \vec{H}$$

i.e., $\mu_{eff} = 3$ for a sphere made of any ferromagnetic material.

Therefore, the magnetic force is approximately

$$F_{mag} = \nabla \left\{ \left[\frac{1}{2} (3\mu_o \vec{H} \cdot \vec{H}) - \frac{1}{2} (\mu_o \vec{H} \cdot \vec{H}) \right] V \right\}$$

$$F_{mag} = \nabla (\mu_o H^2 V) = \nabla \left(\frac{V}{\mu_o} B_o^2 \right)$$

$$F_{mag} = \frac{2V}{\mu_o} B_o \frac{dB_o}{dr}$$

It is now possible to determine the field conditions that will result in the translational magnetic force that can be expected to interfere with normal handling. We will assume this occurs when the translational force is equal to one-tenth the force due to gravity. In addition, we will assume that the object is an iron sphere.


$$F_{mag} = 0.1 F_{gravity}$$

$$\frac{2V}{\mu_o} B_o \frac{dB_o}{dr} = 0.1 \rho V g$$

$$B_o \frac{dB_o}{dr} = \frac{0.1 \mu_o r g}{2} = \frac{(0.1)(4\pi \times 10^{-7} \frac{H}{m})(7900 \frac{kg}{m^3})(9.8 \frac{m}{s^2})}{2}$$

$$B_o \frac{dB_o}{dr} = 4.9 \times 10^{-3} \frac{T^2}{m} = 4.9 \times 10^3 \frac{G^2}{cm}$$

Limited measurements made in 1987 *suggest* that translational forces may be "noticeable" above $10^{-4} \text{ T}^2/\text{m}$ ($10^2 \text{ G}^2/\text{cm}$) and equal to the gravitational force above $10^{-3} \text{ T}^2/\text{m}$ ($10^3 \text{ G}^2/\text{cm}$). However, a subset of the observations indicates that much higher values – up to 100 times – are needed to produce problematical translational forces.



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Subject Area: **Static Magnetic Fields**

Safety Signs for Static Magnetic Fields

Effective Date: **July 2004**

Point of Contact: [Static Magnetic Fields Subject Matter Expert](#)

The Safety Signs for Static Magnetic Fields are provided as PDF files in the table below.

Sign #1	0.5 mT (Caution)	PDF
Sign #2	10 mT (Notice)	PDF
Sign #3	60 mT (Caution)	PDF

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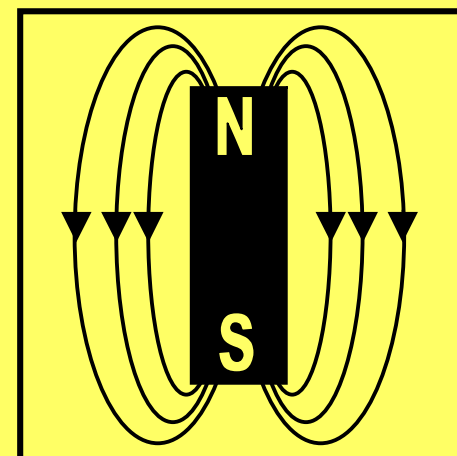


CAUTION

MAGNETIC FIELD HAZARD

FIELDS $\geq 0.5 \text{ mT}$ (5 G)

- **MEDICAL EVALUATION
REQUIRED FOR PERSONS
WITH**
 - * **CARDIAC PACEMAKERS**
 - * **ELECTRONIC MEDICAL
IMPLANTS**



SEE ESH COORDINATOR FOR DETAILS

NOTICE

MAGNETIC FIELD AREA

Magnetic Memory Materials

May Be Damaged

(credit cards, badges, disks, etc.)

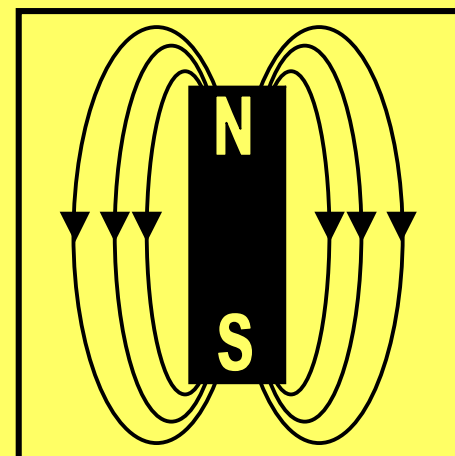


CAUTION

MAGNETIC FIELD HAZARD

FIELDS ≥ 60 mT (600 G)

- TRAINING REQUIRED FOR ROUTINE EXPOSURE
- LOSS OF CONTROL OF FERROMAGNETIC MATERIALS MAY OCCUR
- MAGNETIC MEMORY MATERIALS MAY BE DAMAGED
- HAZARDOUS TO MEDICAL IMPLANTS AND PROSTHESES
- POTENTIAL EXISTS TO EXCEED OCCUPATIONAL EXPOSURE STANDARDS



SEE ESH COORDINATOR FOR DETAILS

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Subject Area: **Static Magnetic Fields**

Static Magnetic Fields Exposure Form

Effective Date: **July 2004**

Point of Contact: [Static Magnetic Fields Subject Matter Expert](#)

Use the Static Magnetic Fields Exposure Form to document magnetic field sources.

Static Magnetic Fields Exposure Form (Use for sources at or above 0.5 mT [5 G])	Word	PDF
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Static Magnetic Fields Exposure Form Instructions

Initial Assessment

The Line Managers or Principal Investigators controlling the static magnetic field source ensures that an assessment of magnetic fields is conducted to determine if an activity is reasonably expected to exceed the exposure limits presented in the exhibit [BNL Static Magnetic Fields Exposure Limits](#).

Complete the Static Magnetic Fields Exposure Form. Submit the form as indicated on each part of the form. Update and resubmit the form when changes occur.

Use of Equivalent Document

The use of the Static Magnetic Fields Exposure Form is not mandatory provided that written documentation of equivalent content is maintained and submitted in a timely manner. Required contents in the written documentation are

- Location of magnets including department, building, room, or area;
- Description of use of magnets;
- Map of magnetic field strengths;
- Potential for exposure
 - Determination if any locations exceed any of the exposure limits;
 - Determination if any users will exceed any of the limits;
 - Frequency of exposure and the average dose expected;
 - Identification of exposed users by name, Life Number, and generic job title;

- Identification of pacemaker users and ferromagnetic prosthetic device users.
- Control measures to minimize exposure (signs, rotation, boundaries, limits, etc.);
- Evaluation of safety potential from rotational forces on ferromagnetic materials.

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BNL Static Magnetic Fields Exposure Form

Part A: Source Hazard Assessment Record

USE THIS FORM TO DOCUMENT MAGNETIC FIELD SOURCES THAT ARE AT OR EXCEED 0.5mT (5 GAUSS)

Line Managers or Principal Investigators, and ES&H Coordinators complete a separate form for each Static Magnetic Field source. This assessment applies to occupational exposures only. This assessment does not apply to unmodified consumer products (phones, computer terminals, magnetic stirring devices, refrigerator magnets, etc.) that are used as intended.

I. Source Identification		
Department:	Building:	Room or Area (location of source):
Identifier/ Name of Source:		
Status of Source Usage (check all that apply): <input type="checkbox"/> In use on frequent basis <input type="checkbox"/> Planned use in the near future <input type="checkbox"/> Possible future use <input type="checkbox"/> No planned use <input type="checkbox"/> Intermittent use <input type="checkbox"/> One-time use <input type="checkbox"/> Other:		
Check or Describe Use or Process: <input type="checkbox"/> permanent magnet <input type="checkbox"/> medical device <input type="checkbox"/> Magnetic Resonance Imaging equipment <input type="checkbox"/> Nuclear Magnetic Resonance equipment <input type="checkbox"/> super-conducting coils <input type="checkbox"/> magnetometers <input type="checkbox"/> accelerator magnets <input type="checkbox"/> detector magnets <input type="checkbox"/> ion pumps <input type="checkbox"/> electron microscope <input type="checkbox"/> beam transport magnet <input type="checkbox"/> electromagnet lifting device <input type="checkbox"/> other (specify):		
II. Exposure Summary [Complete Part B: Field Strength Measurement Record or attach documentation from manufacturer]		
Target Body Area	BNL Exposure Limits	
	(mT)	(G)
Cardiac Pacemaker (Ceiling)	0.5	5
Ferromagnetic Objects (Ceiling)*	60	600
Torso or Head (Whole Body) (8-hour TWA)	60	600
Extremities (Limbs) (8-hour TWA)	600	6,000
Whole Body (Ceiling)	2,000 (2 T)	20,000
Extremities (Limbs) (Ceiling)	5,000 (5 T)	50,000
*Ferromagnetic Objects (Ceiling), including medical implants and prostheses, may be affected by fields. Additional evaluation is required.		
Maximum Exposure Potential surveyed applicable to worker exposure:		
III. Exposure Hazard Evaluation [Check all that apply]		
1. <input type="checkbox"/> Field Strength does not exceed 0.5mT (5 Gauss). Go to section V.		
2a. <input type="checkbox"/> Field strength is at or exceeds 0.5 mT (5 Gauss). No potential for individuals with medical electronic devices to be exposed above exposure limits. Explain in line 4.		
2b. <input type="checkbox"/> Field strength is at or exceeds 0.5 mT (5 Gauss). Individuals with medical electronic devices* may be affected. List users of cardiac pacemakers and other medical electronic devices in Part C: Employee Exposure Record.		
3a. <input type="checkbox"/> Field strength is at or exceeds 60 mT (600 Gauss) but for less than 8 hours TWA. No individuals with medical electronic devices* or ferromagnetic implants/prostheses** present.		
3b. <input type="checkbox"/> Field strength is at or exceeds 60 mT (600 Gauss) but for less than 8 hours TWA. Individuals with medical electronic devices* or ferromagnetic implants/prostheses** may be affected. List users of medical electronic devices or ferromagnetic implants/prostheses in Part C: Employee Exposure Record.		
3c. <input type="checkbox"/> Field strength is at or exceeds BNL Exposure Limit (8-hr. TWA or ceiling limit). No potential for individuals to be exposed above BNL Exposure Limit. Explain in line 4.		
3d. <input type="checkbox"/> Field strength is at or exceeds BNL Exposure Limit (8-hr. TWA or ceiling limit). Potential for individuals to be exposed above BNL Exposure Limit. List the names of individuals in Part C: Employee Exposure Record.		
* Medical electronic devices includes cardiac pacemakers, electronic inner ear prostheses, insulin pumps.		
** Ferromagnetic implants/ prostheses includes aneurysm clips, replacement hips.		

BNL Static Magnetic Fields Exposure Form

Part A: Source Hazard Assessment Record

4. Describe job/task and potential for employee exposures (e.g., type of work performed around source, method of control, time spent in fields [hours/day] and method of determining exposure):

5. Frequency of exposure (e.g., # days per year or month, # tests per year, in continuous use, etc.):

IV. Precautions / Engineering & Administrative Controls

Precautions During Use (check all that apply):

- | | |
|---|--|
| <input type="checkbox"/> Signs | <input type="checkbox"/> Lights |
| <input type="checkbox"/> Barriers | <input type="checkbox"/> Restricted access |
| <input type="checkbox"/> Rotation of workers | |
| <input type="checkbox"/> Working when de-energized | |
| <input type="checkbox"/> Use of nonferromagnetic tools | |
| <input type="checkbox"/> Physical indicator of fringe fields (e.g., use of string with paper clips or equivalent) | |

Other:

Written Documentation:

- ☐ Experimental Review ([Work Planning and Control for Experiments and Operations Subject Area](#))
☐ Work Planning and Control ([Work Planning and Control for Experiments and Operations Subject Area](#))
☐ Written SOP (describe):

Other workers who may require information/written documentation/training to enter this area:

Checklist:

- Employee training required: ☐ Static Magnetic Fields Web Course ☐ Dept/Division-Specific Training
Supervisors training required: ☐ Static Magnetic Fields Web Course ☐ Dept/Division-Specific Training
Training required to be linked in Job Training Analysis for affected work groups / job classifications: ☐ yes ☐ no
Medical approval required for individuals with medical electronic devices ☐ yes ☐ no
Medical review required for individuals above 8-hour TWA or ceiling ☐ yes ☐ no

V. Initial Assessment

Completed by:

Date:

Reviewed by ES&H Coordinator:

Date:

Forward the original form to the Static Magnetic Fields Subject Matter Expert, copies to your ES&H Coordinator and Facility Support Representative. Retain a copy in your files. Update and resubmit the assessment when changes occur.

BNL Static Magnetic Fields Exposure Form

Part B: Field Strength Measurement Record

Field Strength Measurement Record	
DATE:	SURVEYOR:

I. AREA INFORMATION			
DEPT.:	BLDG.:	ROOM:	
SOURCE:			
CONTROLS:	___ BARRIERS	___ SIGNS	___ USE NON-FERROMAGNETIC TOOLS ___ OTHER:

II. SURVEY INSTRUMENT INFORMATION		
INSTRUMENT:	MODEL:	SERIAL#:
FACTORY CALIBRATION DATE:	FUNCTIONAL CHECK (Test of meter response to known magnetic source) DATE:	

III. SAMPLING INFORMATION & RESULTS				
HAZARD: STATIC MAGNETIC FIELDS	UNITS:	___ mGauss	___ Gauss	___ mTesla ___ Tesla ___Amp/meter

[illegible]

BNL Static Magnetic Fields Exposure Form

Part B: Field Strength Measurement Record

Continuation of Section III.

INDICATE WHERE READINGS WERE TAKEN IN THE TABLE BELOW AND ON THE SKETCH (GRID) BELOW. EQUIVALENT METHODS OF DOCUMENTATION CAN BE ATTACHED (E.G., PICTURE, PLAN VIEW WITH EXPOSURE LEVEL INDICATED)

[illegible]

Sketch of Survey Area. (Indicate positions on map where measurements were made.)

[illegible]

Forward the original form to the Static Magnetic Fields Subject Matter Expert, copies to your ES&H Coordinator and Facility Support Representative. Retain a copy in your files. Update and resubmit the assessment when changes occur.

FILE CODE: JH95SR.

FORM IH-SMF (v1.0)

BNL Static Magnetic Fields Exposure Form

Part C: Employee Exposure Record

Employee Exposure Record

DATE:

COMPLETED BY:

I. AREA INFORMATION

DEPT.:

BLDG.:

ROOM:

SOURCE:

NOTE: MEASUREMENTS OR CALCULATIONS IDENTIFY THE INDIVIDUALS BELOW TO HAVE THE POTENTIAL FOR EXCEEDING REGULATORY EXPOSURES LEVELS.

II. EMPLOYEE INFORMATION

FIRST NAME:

LAST NAME:

BNL #:

DEPT:

BLDG:

JOB TITLE:

EXPOSURE DURATION (Hrs):

EXPOSURE (Times per Day):

EXPOSURE (Days per Yr):

JOB/TASKS PERFORMED:

Check all that apply:

☐ MEDICAL ELECTRONIC DEVICE USER

or

☐ FERROMAGNETIC PROSTHESIS &

☐ Exposure above BNL Exposure Limit

☐ Exposure above 5 Gauss

FIRST NAME:

LAST NAME:

BNL #:

DEPT:

BLDG:

JOB TITLE:

EXPOSURE DURATION (Hrs):

EXPOSURE (Times per Day):

EXPOSURE (Days per Yr):

JOB/TASKS PERFORMED:

Check all that apply:

☐ MEDICAL ELECTRONIC DEVICE USER

or

☐ FERROMAGNETIC PROSTHESIS &

☐ Exposure above BNL Exposure Limit

☐ Exposure above 5 Gauss

FIRST NAME:

LAST NAME:

BNL #:

DEPT:

BLDG:

JOB TITLE:

EXPOSURE DURATION (Hrs):

EXPOSURE (Times per Day):

EXPOSURE (Days per Yr):

JOB/TASKS PERFORMED:

Check all that apply:

☐ MEDICAL ELECTRONIC DEVICE USER


or

☐ FERROMAGNETIC PROSTHESIS &

☐ Exposure above BNL Exposure Limit

☐ Exposure above 5 Gauss

Forward the original form to the Static Magnetic Fields Subject Matter Expert, copies to the Occupational Medicine Clinic, your ES&H Coordinator, and Facility Support Representative. Retain a copy in your files. Update and resubmit the assessment when changes occur.



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Definitions: Static Magnetic Fields

Effective Date: **July 2004**

Point of Contact: [Static Magnetic Fields Subject Matter Expert](#)

Term	Definition
BNL Exposure Limits	BNL-adopted exposure standards for workers taken from the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values. It is believed that nearly all workers may be repeatedly exposed to fields less than these limits, day after day, without adverse health effects. An administrative exposure limit was also selected for evaluation of ferromagnetic objects.
ceiling limit	The concentration that should not be exceeded during any part of the working exposure.
Gauss (G)	Magnetic flux per unit area (using the centimeter-gram-second unit system) [1 G = 10^{-4} T] or [1 G = 0.1 mT] or [10 G = 1 mT].
limbs	The arms and legs.
medical electronic devices	Any electronic medical assistance device used by an individual, such as an inner ear prosthesis, cardiac pacemaker, automatic internal cardiac defibrillator, or external or implanted drug infusion pump (e.g., insulin).
process owner	The project manager, principal investigator, or facility manager most directly responsible for the process in which the equipment is used.
static magnetic fields	<p>For the purposes of this document, a static magnetic field is taken to be any field (1) having a frequency of oscillation of less than 1 millihertz (mHz) or an onset and decline separated by more than 1 kilosecond, or (2) characterized by a fixed polarity that is maintained for times in excess of several hundred seconds. An example is the constant component of the earth's magnetic field. Fields that alternate at frequencies below 1 mHz, or have onset and decline separated by 1 kilosecond or more, are considered to be called static.</p> <p>Note: This time interval is already used frequently as an exposure-limiting interval in guidelines dealing with other parts of the spectrum. It is also a long interval compared with the period of the</p>


	spectrum. It is also a long interval compared with the periodicities related to the lowest brain-wave frequencies commonly studied, and it is a short interval compared with physiological and biochemical biorhythms. Thus, it provides a convenient demarcation point with which to distinguish between static and extremely low frequency fields. [ACGIH]
Time-Weighted Average (TWA)	The time-weighted average (TWA) concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect. [Measured Exposure (G or T)] x [Time of Exposure (min.) divided by 480].
Threshold Limit Values (TLVs)	Threshold Limit Values (TLVs) refer to static magnetic field flux densities to which it is believed that nearly all workers may be repeatedly exposed day after day without adverse health effects.
Tesla (T)	Magnetic flux per unit area (SI unit) [1 T = 10^4 G] or [1 mT = 10 G].
whole body	The trunk and head.

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2.0-072004/standard/1u/1u00I011.htm

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Revision History: Static Magnetic Fields

Point of Contact: [Static Magnetic Fields Subject Matter Expert](#)

Revision History of this Subject Area

Date	Description	Management System
July 2004	This revision includes updated procedures and guidelines to ensure the subject area meets the regulatory requirements for DOE Order 440.1A-mandated American Conference of Governmental Industrial Hygienists (ACGIH) threshold exposure limit values. The contents of the subject area and the titles of the subsections in the section Static Magnetic Fields Exposure Controls are revised to clarify that the exposure standards cannot be exceeded. In the exhibit Safety Signs for Static Magnetic Fields, the number of signs is reduced from six to three and the modification combines requirements to improve clarity and eliminate confusion. The Static Magnetic Fields Flowchart is deleted from the subject area as it was too complicated to be easily used. The exhibits BNL Static Magnetic Fields Exposure Limits and Control Requirements for Static Magnetic Fields are updated. The Static Magnetic Fields Exposure Form for Very Low Sources is deleted from the subject area.	Worker Safety and Health

March 2001	<p>This subject area provides procedures and guidance for the assessment and control of potential hazards associated with exposure to static and magnetic fields. Examples of magnetic field sources at BNL are permanent magnets, Magnetic Resonance Imaging (MRI) equipment, Nuclear Magnetic Resonance (NMR) equipment, superconducting coils, accelerator magnets, detector magnets, DC magnets in radio frequency and microwave tubes, ion pumps, electron microscopes, beam transport magnets, electromagnetic lifting devices, and magnetic stirring devices.</p> <p>This subject area provides BNL exposure limits, and associated reporting, training, and posting requirements, to ensure that staff can safely perform work around static magnetic fields. Templates are included to facilitate the documentation process.</p>	Worker Safety and Health
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